Math 120 - Fall 2022
Final Exam

NAME (First,Last) (same as in Canvas): ....

UW email: ....

Student ID ....

Section ....

- You have 2 hrs and 30 min to complete this exam.

- Make sure your writing is clear and dark enough.

- Unless stated otherwise, you **MUST** show work for credit.

- Your work needs to be neat and legible.

- Unless the problem gives you different instructions, you can give exact answers or round off your answers to 2 decimal places.

- The only calculator allowed is the TI 30X IIS. You are allowed two 8x11 sheets of notes, written both sides.

- Box your final answer, when appropriate.

- Raise your hand if you have a question.

- IMPORTANT: when you are done, scan your exam into Gradescope. Please make sure your scan is readable and complete. You MUST also turn your exam in.

1. Bob runs around the circle pictured below, in the counterclockwise direction. The center of the circle is at C (1,4). It takes Bob 1 hour and 10 minutes to run around the circle once. At time $t = 0$, Bob starts running from some point A on the circle; after 40 minutes he is at B (1, 9); B is the Northernmost point on the circle.
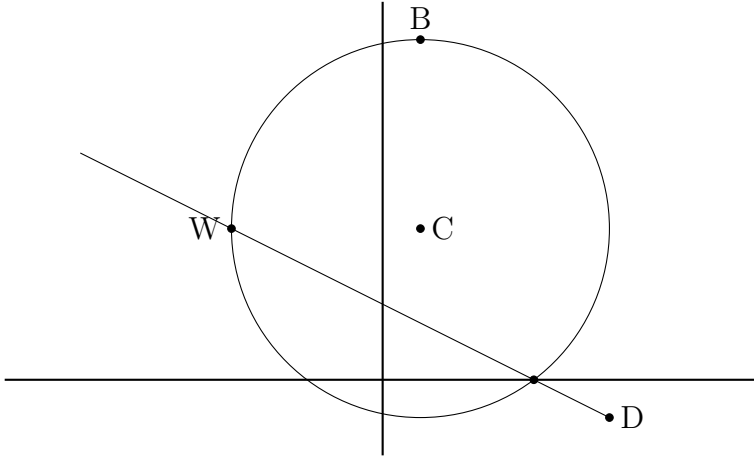
(a) Find Bob's x and y coordinates t minutes after he starts running.

(b) Ann starts running at the same time as Bob. She starts at D and runs along the line DW. W is the Westernmost point on the circle; D has coordinates (6,-1). Ann reaches W at the same time as Bob. Find Ann's x and y coordinates t minutes after she starts running.

2. Quantity A oscillates sinusoidally between a minimum of 2 and a maximum of 12. Tomorrow (t=1) the value of the quantity will be 7 and raising and it is expected to be down at 7 again 9 days from today (t=9). Find a formula that gives the value of quantity A t days from today.

The value of quantity B t days from today is given by the function $f(t) = 22\sin(\frac{\pi}{10}(t-3))+5$. Sam needs quantity B to have a value above 12 for (non consecutive) intervals of time that add up to 30 days. How long does Sam have to wait? (Give your answer in days from today: for example after 42.35 days from today, quantity B will have been above 12 for 30 days).

3. Jack is standing on a cliff 15 feet above the sea. He kicks a ball into the sea. The height of the ball above the sea, t seconds after being kicked, is described by a quadratic function $h(t)$. You know that $h(0) = 15$ and that the ball reaches its maximum height of 35 feet above the sea 7 seconds after being kicked.

(a) Find a formula for h(t).

(b) Find the time t_1 when the ball hits the water.

(c) At what time, when the ball is going up, is it 30 feet above the sea?

(d) Find a formula for the function $t = g(y)$, that gives you the time when the ball is going up and it has height y feet above the sea. Give the domain and range for g.

4. At 9 am today the value of a certain stock is \$1 per share. During the morning, that is until 12 pm, the value of the stock increases exponentially, doubling every 1.5 hours, but in the afternoon the value decreases at a constant rate (that is linearly), reaching a value of \$2 per share at 5 pm.

   (a) Write a multipart formula for the function f(t), that gives you the value of the stock t hours after 9 am, in the time interval between 9 am and 5 pm today.

   (b) Draw a graph of $f(t)$. Mark all relevant points on the graph.
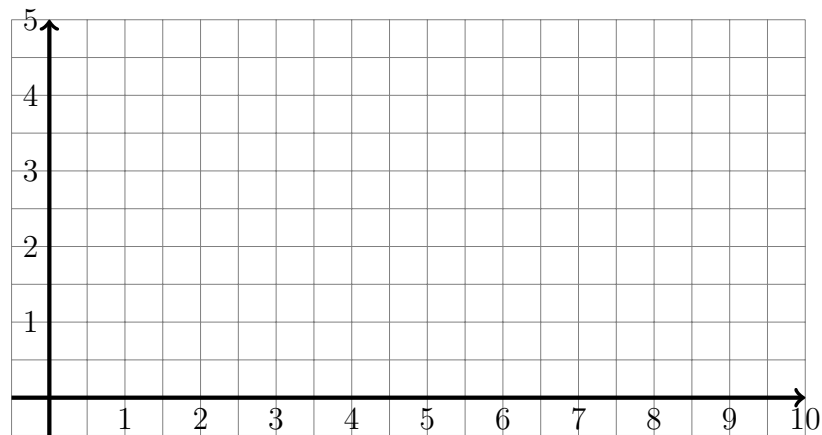
   (c) Jack tells you he bought the stock today at \$3 per share. Find all times when Jack could have bought the stock. Give your answer as a time of the day: for example at 2:43 pm.

5. You have 10 feet of wire. From these 10 feet, first you cut z feet of wire and you bend it into a semicircle, then you use the rest of the wire to form three sides of a rectangle and you connect to the semicircle as shown in the figure below. What should z be, if you want the region enclosed by the wire to have the maximum possible area ? (Remember that the area of a circle of radius r is πr^2, and the circumference of a circle of radius r is $2\pi r$).